

was, on the balance, practically no advantage. In the discussion which followed, Mr. Charles Wood said that when iron ore and limestone were calcined together there was a distinct gain. We gathered from Sir Lowthian's reply to the discussion that he had not tried the plan Mr. Wood referred to—and which the latter had been following for twenty-five years—but that he would make further experiments on those lines. Perhaps the most striking feature in connection with this paper and discussion is its illustration of the value of societies of the nature of the Iron and Steel Institute. Here we have one practical detail which cheapens the cost of iron-making—at least, that is the opinion of a very competent ironmaster—in use for years, and it might have remained unknown to the majority of manufacturers had not the fact been elicited in this discussion. If Mr. Wood be right in his contention, he will doubtless receive confirmation from Sir Lowthian Bell at a subsequent meeting.

Mr. Hogg's paper followed, and in it were given the results of a large number of experiments, from which the author concluded that in the purer classes of iron the tendency of carbon to be retained in a combined state is prevented by the addition of 1 per cent. of aluminium, but curiously enough every increase above that percentage has an opposite tendency. It was also stated that the more rapidly cooled ferro-carbon alloys containing aluminium also contain a larger proportion of graphite. A short discussion followed the reading of this paper, and the meeting was then adjourned until the next day.

On the members reassembling on the following day, Wednesday, August 22, Mr. Selby Bigge's paper was first read. The author gave some interesting particulars of the progress that has been made in Belgium in using electricity as a means of distributing power in factories and workshops. The question has become one of commercial expediency, and the author boldly attacks it from this point of view, stating that his "whole contention in advocating electricity as the right and proper agent of operating new works, and as a means whereby old works can be remodelled, may be summarised by the one word 'economy.'" As an instance in point, he quoted the National Arms Factory at Herstal, near Liège. These works were recently founded to execute, in the first instance, an order for 200,000 rifles, the production being guaranteed at 250 rifles every twelve working hours. The Compagnie Internationale d'Electricité supplied the electric power installation, laying down thirteen motors, ranging between 16 and 37 horse-power, and giving a total of 260 horse-power. For the former size of motors they guaranteed a commercial efficiency of 87 per cent., and for the latter 89 per cent. The total power of the motors (260 horse-power) would therefore be obtained by 296·9 initial horse-power. There was a large amount of electric lighting to be done also, so that an engine and dynamo of 500 horse-power was installed. The ratio between the electric energy available and the energy transmitted to the shaft by the engine was guaranteed to be 90 per cent. The electric motors drive the line shafting of the machines, and the efficiency of transmission—that is to say, the ratio between the power available and the effective horse-power developed by the steam engine—is given by the product of three efficiencies, as follows:—90 per cent. for the dynamo, 98 per cent. for the conductors, and 87 per cent. for the motors = 76·6 per cent. The installation has now been running for three years without being the cause of cessation of work for a single minute.

It is a very difficult matter to form comparisons between the respective efficiencies of different methods of power distribution, and it may be pointed out that in the Herstal case the electric system does not appear to its greatest advantage, as the motors drive line shafting in place of being attached directly to the machines. There is no doubt, however, that a very strong case can be made out for electricity, and electrical engineers may look forward with confidence to a large extension of their field of activity in regard to power distribution.

The paper of M. Lencauchez dealt with a novel description of open hearth furnace in which jets of air and gas appear to be blown on the bath of molten metal to assist oxidation. The device did not receive much commendation in the discussion which followed the reading of the paper, but in the absence of illustrations referred to by the author, it was very difficult for those who had not had the advantage of seeing the furnace to follow the description.

The paper of Mr. McMillan, on colour gauges, was read in brief abstract, and Mr. Wilson's paper was also considerably curtailed in delivery, the time of the meeting having expired.

There were several excursions in connection with the meeting. The first, on the Tuesday afternoon, was to the Antwerp Exhibition, and on Wednesday evening members were received by the King of the Belgians, at the Royal Palace in Brussels. This was the chief feature of the meeting, the King receiving his guests in person, and apparently thoroughly enjoying the many conversations he had with the English metallurgists and engineers present. On the Thursday and Friday of the meeting, visits were paid to steel works, collieries, glass works, and engineering establishments. The last excursion on the list was to the important works known as the Société Cockerill at Seraing, near Liège. These works date from the beginning of the century, having been founded by a British subject, we believe a Scotchman. At present 5500 workmen are employed. According to particulars given to members in the shape of a handbill, there are five blast furnaces, an open steel plant, a basic steel plant, 250 coke ovens, 40 puddling, 15 reheating furnaces, 10 rolling mills, 3 foundries, 9 winding engines, 5 pumping engines, 4 blowing engines, 28 engines for rolling mills, 204 machine tools, 14 locomotives, and 184 steam boilers supplying 17,000 horse-power. The Company has also a shipbuilding establishment at Hoboken.

PHYSIOLOGY AT THE BRITISH ASSOCIATION.

THE meeting of the Association this year was a memorable one for physiology, since this subject was for the first time placed by the Council on an independent footing. This action of the Council has been amply justified by the success of the new Section I, there being a very representative attendance of English and continental physiologists, and great wealth of material for their consideration. The number of papers was so large that even when the sittings were extended to the final Wednesday morning, the business of the Section could only be got through with difficulty, and the opinion of all concerned was emphatic as to the high quality and great interest of many of the communications. In addition to the sectional meetings, advantage was taken of the presence of so many physiologists to dovetail a meeting of the Physiological Society into the proceedings; this was held on Saturday afternoon, when several interesting communications were made, and the meeting was followed by the dinner of the Society in Magdalen College, under the presidency of Prof. Burdon Sanderson.

The following summary will furnish a general account of some of the chief points in the many varied papers read before this Section:—

Thursday, August 9.—The proceedings opened with a communication by Mr. M. S. Pembrey, on the reaction of animals to changes of external temperature. The observed reaction was that of the production of heat, this being estimated by the amount of CO₂ discharged from the animal. Experiments upon the mouse were described, which showed that in proportion as the external temperature was lowered, the CO₂ output of the animal was rapidly increased (in one minute the increase amounted to 60 per cent. when the temperature fell from 33° to 17° C.), and concurrently with this increase the animal's muscular activity became far more vigorous. Experiments made upon the developing chick showed that up to the twenty-first day the effect of external cold was to decrease the CO₂ output, the chick in this stage behaving like a cold-blooded animal, but that a comparatively sudden change took place from this day onwards, the chick reacting like the warm-blooded animal previously referred to. This change in reaction is probably related to the development of the neuro-muscular mechanisms, and is undoubtedly influenced by the activity of the animal. Observations made upon newly-hatched pigeons showed that these birds, being more or less helpless when hatched, react for the first few days like cold-blooded animals, the output of CO₂ decreasing with a fall in the external temperature; it is probably for this reason that these young birds are kept warm by the parent until their muscular activity is more developed. The influence of the muscular activity upon the production of heat was further shown by details of observations made upon mice after section of the spinal cord, as well as during anaesthesia; in both cases the muscular paralysis was accompanied by a change in the reaction, which now resembled that of a cold-blooded animal.

Mr. Harris described the results of an investigation into the

muscular rhythm of voluntary tetanus in man. The muscle thrill during contraction was ascertained by recording the continuous contraction in a great variety of ways, as well as by ascertaining through a suitable telephone and microphone the muscle note. The observations confirmed in the main those of Schäfer and of Griffith, and indicated that the thrill was due to a muscle vibration, the rate of which varied from 10 to 15 in the second, with an average of about 12 or 13 vibrations.

Prof. Allen gave a short demonstration of mirror writing.

Prof. McKendrick showed a phonograph, and demonstrated some of its effects to the audience. He explained the working of the instrument and the means by which he was now endeavouring to adapt it for such physiological investigations as those connected with the nature of the vowel and consonant sounds, and those in which it was desirable to obtain a permanent record of the cardiac and respiratory sounds. He then showed a new model, constructed by himself, to illustrate a possible mode in which the essential structures of the basilar membrane of the cochlea might be supposed to respond to compound tones. The model consisted of a glass box containing two cavities separated by a horizontal membrane and filled with liquid, the box communicating with the exterior by two apertures covered by membrane analogous to the fenestræ ovalis and rotunda. Two pistons rested by their bases on the horizontal membrane, and could be arranged of such size and weight that their periods of vibration should be as 1:2. In this scheme it was shown that in accordance with the rate of vibration communicated to the liquid the two pistons responded in variable amounts, thus analysing the wave in the liquid.

Prof. Gaulle showed microscopic specimens and slides illustrating the remarkable changes observed by himself as following the section in the rabbit of the inferior cervical sympathetic ganglion or its branches. After a definite lesion these changes were found to be localised in particular muscles and special parts of the nervous system. Thus he found that after section of one branch of the ganglion the observed changes occurred in the rami communicantes, the lower cervical spinal cord, the anterior roots of the brachial plexus, and the biceps muscle of the forelimb. He considered that the changes indicated trophic disturbances in the affected parts due to the lesion, and showed muscles in which the substance had suffered at various points the alteration in question.

Prof. Haycraft described an extensive research which he had made upon the development of the kidney, and showed a large number of micro-photographs to illustrate his remarks. The examination of continuous series of sections through this organ in different stages of its early growth, had convinced him that both the glomerular and tubular portions of the gland substance were formed as ingrowths from the same epithelium, viz. that lining the genito urinary canal. The view thus advanced as to the development of the kidney makes it analogous to that of other glands in opposition to former opinions.

Friday.—The Section commenced with the opening address of its President, Prof. Schäfer. This was followed by a communication by Prof. Heger, on the unequal diffusion of poisons into the organs of the body. In this paper an account was given of some of the chief means by which the organism was continually struggling against toxic substances, the principal objects to be effected being either the elimination of the unaltered poison, its neutralisation, or its destruction. The neutralisation might be either a true chemical combination, as in the case of CO_2 , or a physical localisation in some special organs which could endure this excess, and so remove it from the rest of the organism. Thus morphine, if given in a series of increasing doses, accumulated in the liver, spleen, and marrow of the bones. In the case of microbic poisoning, Prof. Heger, whilst admitting that the constant multiplication of the microbes necessitated the destruction of the poison by phagocytosis, &c., pointed out that some such process of neutralisation as that just referred to was not only a possible but a probable antecedent to this destruction. Thus the liver cells and their secretion or extract appeared to have exceptional antitoxic properties. Experiments were quoted which showed the extent to which the frog's liver could not only retain and digest such poisons as hyoscyamine, but actually utilise the products derived from them as a food supply for the organ.

Mr. Hurst explained a new hypothesis as to the mode in which he conceived the organ of Corti and adjacent structures might be supposed to be affected by such alterations of pressure in the endolymph as must be produced by sound waves.

Prof. Schäfer showed photographs to illustrate a research made by Dr. Oliver and himself as to the functions of the suprarenal bodies. The photographs were chiefly those of tracings indicating the blood pressure, the heart beats, and the volume of the blood-vessels in such localised parts as a limb or the kidney. The injection of suprarenal extract was seen to cause a great rise of blood pressure, due not to any modification in the heart beat, but to the constriction of the blood-vessels, this constriction being dependent upon the integrity of the central nervous system.

Prof. Rutherford showed the result of an extensive series of observations in which the reaction time was measured for sight, hearing, and touch. The stimulus for the ear was the response of a telephone to a current, that for the eye the movement of an electro-magnetic signal, and that for the touch an induction current sent through the skin; the stimulus in all cases being made by the closure of a circuit. The response of the individual was the break of a current sent through a suitable electro-magnetic recording arrangement. By means of the pendulum a large series of records were obtained, in which as the initial starting-point occurred always at one place, and the different observations were arranged in series beneath one another, a comparison between different reaction times was rendered very conspicuous. He found that with eight intelligent men of ages varying from 19 to 62, the time for sight varied from $\frac{1}{100}$ to $\frac{1}{1000}$ second, for hearing, $\frac{1}{100}$ to $\frac{1}{1000}$, for touch, $\frac{1}{100}$ to $\frac{1}{1000}$. The shortest reaction times were obtained when the response was that of the hand on the same side of the body as the ear or cheek which was stimulated.

Mr. D'Arcy Power showed a series of preparations of the conjunctival and vaginal mucous membranes taken from rabbits and guinea-pigs which had been subjected to mechanical and chemical irritation. Many of the epithelial cells presented appearances which were identical with those described as being parasitic when they were met with in cancer. The changes in the epithelium were summarised as a general vacuolation of cells; various forms of intracellular œdema; epithelial "pearls," collections of leucocytes, and the spaces left after these leucocytes had migrated. The series of preparations shown on the present occasion indicated that many squamous epithelial cells had the power of phagocytosis, for in no other way could the remarkable intracellular appearances be explained; cells were shown containing a leucocyte, and others containing a microcyte. Partial necrosis of the cell also took place as a result of irritation, and there was an invasion of large eosinophile cells into the conjunctival epithelium.

Saturday.—Prof. Hermann gave a most interesting communication upon the production of vowel and consonant sounds. His investigations were made by means of the phonograph, the excursions of the stylus being magnified, for which purpose a small mirror was attached to this part, and the character of its movement recorded by photographing the reflection in the mirror of a beam of light. Observations were also made in which a special telephone was introduced, thus rendering the excursions still larger. Numerous photographic records of various vowel and consonant sounds were exhibited, and each was seen to produce its own characteristic tracing. A matter of much theoretical interest in connection with the previous work of Helmholtz and others, was the character of the tracing when the same vowel sound was sounded in notes of different intensity but of similar pitch, or *vice versa*.

Prof. Fredericq showed a new aerotonometer and gas pipette, which he had made in order to investigate the causation of the gaseous interchange between the blood and air of the lungs. By means of this apparatus the tension of the gases in these two media had been ascertained, and the results were laid before the Section. These furnished, in the author's opinion, material for criticising the view advanced by Prof. Böhr, that, as the Oxygen tension in the circulating blood often exceeded, whilst the CO_2 tension fell short of, that in the pulmonary air, the interchange could not be brought about in accordance solely with the laws of diffusion, but must be largely modified by the special vital activity of the lung epithelium. Prof. Fredericq's observations led him to believe that the data upon which Böhr's conclusions were founded, might be more or less incomplete owing to the time allowed for the contact between the blood and the air of the aerotonometer being too short in Böhr's apparatus for the correct determination of the tension of the O and CO_2 in that liquid. Fredericq's apparatus allowed of a long time, two hours, for the determination, and he had never obtained as low a tension of CO_2 , nor as high a tension of O, in the blood as

Böhr had found. He therefore concluded that the diffusion hypothesis was adequate to account for the interchange. Dr. Haldane, replying to the above, pointed out that the criticism did not affect those experiments of Böhr's in which the aërotonometer CO_2 tension, although made initially higher than that in the pulmonary air, yet fell in the course of an experiment to a value much below the latter.

Mr. L. Cobbett and Mr. Melsome brought before the Section the results of an investigation on the production of local immunity through a localised specific inflammatory condition. It appeared from the authors' experiments that an attack of erysipelas localised to the ear of the rabbit conferred upon that organ an immunity against subsequent inoculation by the erysipelas organism so long as there was any indication of the inflammatory thickening occasioned by the first attack, and that the only consequence of this subsequent inoculation was a localised non-specific inflammation. The authors regarded this inflammation as the reaction of the affected tissues against the specific poison of the disease, since the absence of the specific *streptococci* indicated that this secondary effect was not due to the invasion of the tissues by the microbes. This view was confirmed by the fact that it was found possible to obtain similar inflammatory effects when the organisms themselves having been destroyed by heat the concentrated filtered culture was injected into the ear. Finally, since the parts which had previously suffered from erysipelas reacted more quickly and vigorously to the subsequent injection of the poison, it seemed probable that this non-specific inflammation was due to some adaptation of the tissues enabling them to respond with greater vigour, and thus more effectively, so that, as Metchnikoff and others have affirmed, the inflammatory process is from one aspect a truly protective one.

Mr. Lorrain Smith and Mr. Trevithick brought forward a research in many respects similar to the foregoing, but with one important difference, since the initial protective inflammatory process was brought about by a simple irritant. A sterilised liquid containing fine glass particles was injected into one pleural cavity of the rabbit and guinea-pig. The injection was followed by hyperæmia of the lung and by inflammatory exudation into the pleural cavity and the subjacent pulmonary alveoli. The subsequent injection of the *Bacillus pyocyaneus* was found to be inoperative as long as the injection was limited to the parts which were the seat of this primary inflammatory process; thus the inflammatory region was rendered immune, the localised immunity produced by the glass lasting as long as twenty-eight days.

Dr. Mann showed a series of microscopic specimens and microphotographs in which changes could be observed in various nerve cells as the result of their functional activity. The cells in question were those of the spinal cord, cerebellum, &c., particularly those associated with the functional activity of the retina, whilst the chief alterations were in the size and chromatin distribution of the cell nuclei. By bandaging one eye of an animal and then exposing it to light, Dr. Mann was able to distinguish an alteration in the size and staining of the cells upon the two sides in the following situations: the outer nuclear layer of the retina, the pyramidal cells of the occipital cortex, and the cells of the external geniculate body. The changes were most conspicuously shown both in the specimens and in the photographs.

At the meeting of the Physiological Society, held on Saturday afternoon, the following communications were made:—Dr. L. Hill showed the effect of gravity in altering the mammalian blood pressure, as illustrated by the remarkable rise in carotid pressure which occurs when the animal is changed from a horizontal to a vertical position with the head down, and the corresponding fall when the animal is similarly placed with the head up. Mr. Kent showed an organism which he believed might turn out to be the specific organism of vaccinia. Dr. Pavy showed a sugar of low reducing power which was obtained from the urine of an animal after the administration of large quantities of dextrose. Dr. Mott showed microphotographs of the medulla, cord, &c., after section of the gracile and cuneate nuclei of the monkey on one side of the medulla. The sections showed the degenerated arcuate fibres sweeping over to the opposite side of the medulla, and the degeneration in the fillet of the opposite side above the lesion. A remarkable point in connection with the changes was that the degenerated fibres could be traced up to the optic thalamus, but no farther, there being none in the internal capsule. He also showed microphoto-

graphs taken from sections of a cord in which a longitudinal section had been made in the lumbar region, the section being in the middle line. The sections showed degenerated fibres in both antero-lateral columns.

Monday.—Dr. Starling gave an account of the experiments which led him to believe that the flow of lymph from the thoracic duct was dependent upon the amount of the blood-pressure in the liver capillaries, and hence that the old mechanical theory of lymph formation was correct as regards this source of the lymph flow. He showed that obstruction of the inferior vena cava must raise the pressure in the portal capillaries, and that a similar result follows obstruction of the abdominal aorta. The flow of lymph which Heidenhain observed after these operations was not therefore necessarily due to secretory activity, but must occur in consequence of the pressure even if the permeability of the portal capillary walls remained unaltered. Similarly the injection of a large quantity of saline into the circulation (hydræmia) caused an increased flow in consequence of the purely mechanical rise of pressure in the liver capillaries, this rise being ascertained by taking simultaneous tracings of the blood pressure in the portal vein and the inferior vena cava. Many lymphagogues act by causing hydræmia, and in these the flow of lymph must be directly caused by the increase in the portal capillary pressure. That the lymph under these circumstances comes from the liver is shown by the absence of the flow from the thoracic duct when the lymphatics of the liver are ligatured. Some lymphagogues, the action of which was especially noted by Heidenhain (such as crayfish muscle extract), stimulate the flow of lymph without giving any evidence of increased pressure in the portal capillaries. The effect of these lymphagogues disappears after long-continued obstruction of the aorta, and on this ground, since the liver lymph still flows, the author concludes that lymphagogues of this class act on other lymph sources than the liver, and probably in the main upon those present in the intestines.

Dr. Lazarus Barlow followed with some experiments upon the flow of lymph from the hind limbs. He found no increase in the flow when considerable though incomplete venous obstruction was maintained for one hour, whilst the specific gravity of the blood, muscles, and skin showed no evidence of any increased exudation. Such increased flow and exudation occurred, however, when, after thus damming up the katabolic products, the tissues under observation were supplied with blood through actively dilated arterioles. The dilatation, when caused by section of the sciatic nerve, led to no such increased exudation; hence he concluded that the demands of the tissue are an effective factor in lymph formation. When the arteries are actively dilated, the amount of exudation varies directly as that of the venous pressure; so that lymph formation, though not a purely mechanical process, is nevertheless simpler than a pure secretion, such, for instance, as exists in the salivary glands.

Messrs. Bayliss and Starling communicated the results of an experimental inquiry into the innervation of the portal vein. The method consisted in reading the pressure in the portal end of the cut splenic vein, which thus formed a side branch of the portal system. They found that the pressure rose when certain definite anterior roots were stimulated, these extending in the lower dorsal region from about the seventh to the tenth dorsal nerves; these, therefore, contain vaso-constrictor nerves for the portal system.

Mr. Bayliss gave a further communication upon vaso-dilator nerves. He showed that the fall of blood pressure which follows the excitation of the central end of the depressor nerve was accompanied by vaso-dilatation, this being evidenced in the case of the kidney by the simultaneous expansion of that organ, and in the case of the lower limbs by their increase of volume as indicated by the plethysmograph. As the vaso-constrictors leave the spinal cord by the lower lumbar roots, the section of the cord in the dorso-lumbar region will cut off the vaso-constrictors, and since, under these circumstances, the stimulation of the depressor still causes an increase in the volume of the limb, he was led to conclude (a) that the dilatation was really due to the increased activity of vaso-dilator centres, and not to the diminished activity of vaso-constrictor centres; (b) that the anterior roots by which the vaso-dilator nerves of the lower limbs leave the cord, extend higher into the dorsal region than is the case with the constrictor nerves. Corroborative experiments were carried out in which the cord was left intact, whilst the sympathetic, in which the vaso-dilators run, was divided. Under these circumstances no increase in the volume of the

limb accompanied the depressor excitation because the dilator supply was cut off.

Prof. Waymouth Reid gave an account of the alteration in the mucous membrane of the lateral pouches of the pigeon's crop, which were associated with the breeding season of the bird, and resulted in the formation of masses of fat-holding material constituting the so-called *pigeon's milk*. The secretion of this material is in its histological features analogous to the formation of sebum in the sebaceous glands, the fat being contained in cells which are cast off in masses from the mucous surface. The material is used for feeding the young pigeon, and when analysed is found to contain from 7 to 9 per cent of fat and 12 to 15 per cent. of proteids, the chief of which is a nucleo-albumin; unlike true milk it contains no sugar, but among its proteids is a caseinogen which clots with rennet with or without the addition of calcic chloride.

Prof. Dubois read a paper on the production of heat in hibernating animals, and brought forward the results of experiments made on the marmot in order to ascertain what circumstances influence the change which takes place at the end of hibernation. Section of the cord at the level of the fourth cervical nerve interferes with the waking from winter sleep, the delay thus caused being only partially due to the muscular paralysis and consequent inability to produce heat, since it appears that the integrity of the sympathetic system is an essential factor in the process. Further experiments seemed to indicate that the nervous control of the circulation was necessary for the waking up, and that the most important part of the circulation was that through the liver, which under the conditions produced by the section was inadequate for the supply of that organ. In consequence of this inadequate circulation the author believed that the proper functions of the liver were very much interfered with, and that in the normal animal these functions were at the moment of waking very actively carried on, particularly those by which glycogen is converted into sugar.

Prof. Haycraft showed some micro-photographs of collodion casts of muscle fibres in which the transverse striæ of the fibres were displayed. This communication was followed by one from Prof. Rutherford, who exhibited on the screen micro-photographs of muscle fibres both at rest and in contraction.

Tuesday.—A combined meeting of the Physical and Physiological Sections was held in the large theatre of the museum, when Prof. Lodge showed a number of experiments upon the reflection, polarisation, and refraction of Hertz waves, using as a detector for the presence of the propagated electrical disturbance an extremely sensitive cohesion tube. This contained fine particles in imperfect contact, and consequently offering considerable resistance to the passage of an electric current. The surging in the particles of an electric disturbance causes a better contact to be established, and the resistance consequently to be enormously diminished. Prof. Lodge followed this demonstration with a suggestion as to the mode in which it was possible to conceive of a reaction of the retinal structures to light vibrations. If we assume that the retinal elements constitute an imperfect conductor, and that a constant electromotive source is present in the retinal tissues, then it is not improbable that the light waves would cause a sudden diminution in the resistance of the elements, and allow the passage of a previously masked current; this current might excite the nerve-endings, and thus start the necessary nerve impulses. He pointed out that the coherer was acted on not only by the sudden commencement, but also by the sudden cessation, of the Hertz waves, and drew attention to Hering's view that white and black are both positive sensations, and both caused by retinal excitation. He stated that as regards colour, mathematicians only demanded a triple starting-point, and that since in Hering's theory three such independent factors were postulated, no objections to this theory could be raised on that score. The Young-Helmholtz theory seemed to him difficult to reconcile with the facts described by physiologists and observed by himself.

A discussion followed, in which several physiologists took part, the general tendency of the tone being that the suggestion must be capable of being applied to all living electromotive structures which display electrical changes when called into activity. It was also pointed out that the histological appearances were not at any rate opposed to Prof. Lodge's suggestion.

Prof. Osborn described a modification of Golgi's method used

by Mr. Strong, of New York, and showed beautiful photographs of nerve cells from various parts of the central nervous system treated in this way.

Dr. Hildane brought before the Section the evidence which had led him to the conclusion that in the recent colliery explosion in South Wales, and probably in most previous ones, the cause of death by suffocation was the deficiency of oxygen in the mine due to its displacement by the products of the explosion, *i.e.* after-damp. Suffocation by deficiency of oxygen occurs when the respired air contains less than 8 per cent. of O; it is ushered in by an extremely sudden attack of muscular paralysis, so that there is but little warning of the danger when air is inspired deficient in O, and little chance of escape owing to the muscular failure. Suffocation through excess of CO₂ is quite different, as it is preceded by gradual respiratory distress in which the neuro-muscular system is aroused to greater activity. In addition to the deficiency of O, the poisonous "after-damp" contains often at least two noxious gases in fatal percentage, these being CO and H₂S. The most effective method of fighting one's way through after-damp seemed therefore to be one which aimed at restoring to the inspired air an adequate quantity of oxygen, and this the author thought might be effectually done by suitable portable cylinders of this gas.

Mr. W. G. Smith brought forward some observations illustrating some of the mental conditions which influence the association of ideas, *i.e.* memory. Experiments were made as to the effect upon such association of contemporaneous nervous activities other than those which presumably were more or less directly involved. Thus the power of recollecting a given arrangement of letters which had been exposed before the eye for ten seconds was found to be modified by the person under observation having to carry out simultaneously any one of the following among other operations during the period of exposure: tapping rhythmically on the table with the forefinger; speaking a simple syllable over and over again; carrying out a simple sum in addition in an audible voice. In all cases the effect was to confuse the recollection, the degree of confusion being greatest in the last two described instances.

Wednesday Morning.—Profs. Gotch and Lodge demonstrated the method employed by them in order to study the physiological effects produced by rapidly alternating currents of high intensity. They first showed that a nerve muscle preparation from the frog, if held in the neighbourhood of a friction machine to the poles of which were attached Leyden jars, responded by a single contraction whenever a spark passed between the knobs of the machine. Since there was no connection, except an air one, between the preparation and the machine, it was evident that the response was due to the preparation being in the line of force which spreads out from the knobs, and that when the spark passed, the sudden equalisation of these effects must be accompanied by a surging to and fro in the exposed nerve; the sudden character of this excites the tissue. They then showed the following experiment:—

A looped circuit was arranged connecting the two Leyden jars together, but leaving them attached to the friction machine; the end of the loop was connected to the earth, this being essential to avoid all static effects. Two wires were joined, one to each side of the loop, and the ends placed so as to embrace the exposed nerve of a nerve muscle preparation midway between the central end and the muscle. The upper end of the nerve was now brought into contact by means of other separate electrodes with an induction apparatus, and was excited every four seconds by a minimal excitation. On working the friction machine, and passing the strong rapidly-oscillating currents of the Leyden jars through the preparation, it was observed that only when the spark of the friction machine was extremely intense did the preparation respond by a contraction to these rapidly alternating currents, and that the sole effect of rather feeble alternating currents was to so alter the nerve that it ceased for a brief period to transmit the nerve impulse evolved by the constant rhythmical stimulus at the central end. The passage of these currents thus seems to produce a temporary paralysis of the nerve without causing excitation, acting thus like pressure or cold.

Prof. Engelmann described a new kymograph and polyrheotome, and exhibited tracings obtained with the instrument, which showed the great accuracy of the apparatus. The recording surface was driven by means of a weight which was so contrived as to ensure that in each experiment the same velocity should be reached before the weight ceased to act, and the subsequent revolution rendered practically uniform.

Mr. G. J. Burch showed a series of photographs of the excursions of a very sensitive capillary electrometer when projected on to a rapidly travelling plate and actuated by speaking into a telephone placed in the circuit. The excursions formed the basis for calculations of the E.M.F. of such telephone currents as are produced by the sounds of ordinary conversation; this varied from '05 to '1 of a volt, but with louder sounds might be sufficient to produce electrolysis. Photographs were shown which demonstrated that the instrument used could respond to changes of potential difference when these occurred one after another at a rate of nearly 3000 double vibrations in one second. The effect of the sounds of certain vowels and consonants were shown, such as *ah*, *ee*, *z*, and *r*. In each case the fundamental tone of the voice and some of its harmonics combined to give a characteristic electrometer excursion with higher rapid vibrations superimposed upon it. These in the case of *z* were just visible under a lens, and appeared to have a rate of 3000 in one second. Photographs were also shown of the characteristic excursion caused by the pronunciation of the words, "Pop, pop," and "Dod, dod," the difference between the labial and the dental being well marked. Finally another series of photographs was exhibited which demonstrated that when electrolysis occurs in the electrometer, and the evolution of the gas recorded on the travelling photographic plate, this evolution is seen to take place without any measurable delay the instant the electrolysing current commenced.

BRITISH ASSOCIATION CONFERENCES OF THE DELEGATES OF THE CORRESPONDING SOCIETIES.

THE meetings of the Conference of Delegates were held at the New Examination Schools. Forty-two societies nominated delegates to represent them at the Conference.

FIRST CONFERENCE, AUGUST 9.

The Corresponding Societies' Committee was represented by Prof. R. Meldola (chairman), Prof. T. G. Bonney, Sir John Evans, Sir Douglas Galton, Dr. Garson, Mr. Hopkinson, Mr. Cuthbert Peek, Sir Rawson Rawson, Mr. Symons, Mr. Topley, Mr. Whitaker, and Mr. T. V. Holmes (secretary).

The Chairman remarked that this was their tenth Conference. Hitherto the reports of these Conferences had always been a year behind, as regards their publication in the British Association volume; the report of the Conference held at Edinburgh in 1892, for example, appearing in the volume giving an account of the proceedings at Nottingham in 1893. Steps had been taken to prevent this delay in future. They had also taken a new departure in announcing beforehand that some special subject would be discussed at the Conference. On that occasion they had been fortunate enough to secure the attendance of Mr. Cuthbert Peek to open a discussion on Local Museums.

Mr. Cuthbert Peek dealt with the subject under the following headings:—

- (1) Methods of registration and cataloguing.
- (2) The protection of specimens from injury and dust.
- (3) The circulation of specimens and type collections for educational purposes.
- (4) Central referees for nomenclature and classification.
- (5) The most satisfactory methods of making museums attractive.

(6) Museum lectures and demonstrations.

(7) The relations between museums and County Councils.

(1) For small museums he thought a card catalogue was the best. Sectional letters should distinguish the various classes of objects. Each specimen, when received, should have a number under the letter of the section assigned to it, painted on the specimen. It was a good thing to have the dimensions of the specimen, with a rough outline of it, on the back of the card.

(2) Every closed case was acted upon by changes in the pressure of the atmosphere, so that it drew in and gave out air and dust with every change of pressure. It was desirable to admit air into each case by means of an opening filled with cotton-wool, or some similar material, so that the air entering might be filtered.

(3) At Liverpool a system had been elaborated by which loan-collections were prepared and circulated among a large

number of schools. Each collection contained some special class of objects, such as food products, woods, &c. Those wishing to organise a plan of this kind should consult a paper by Mr. J. Chard, in the Report of the Museums' Association for 1890.

(4) The average curator of a small museum was often in difficulties as to the correct names of certain specimens. An organisation of specialists who would, for a small fee, allow specimens to be forwarded to them for identification, would be of the greatest use.

(5) While there were many well-arranged and attractive museums, there were others dusty, with labels illegible or invisible, which were almost unvisited and unknown. The English as well as the Latin names of specimens should be given. Much might be done to exhibit the variations of structure in creatures of different families or genera. Thus, in the Natural History Museum, South Kensington, there had recently been placed the skeletons of a man and of a horse, both in the attitude of running, so that the relations of the two, bone for bone, could be distinctly seen. The surgical, ordinary, and veterinary names of the bones were added.

(6) It was extremely difficult to make a museum demonstration useful to more than about a dozen persons. One experienced demonstrator had suggested that a lecture should be given in an ordinary lecture-room, illustrated by specimens, &c., to the whole of a large gathering, and a case-demonstration afterwards to the few seeking further information. The demonstrator should be placed on a temporary stand, so that he might see, and be seen by, his audience.

(7) It had always appeared to him that demonstrations in museums should take a very prominent part in technical instruction, and he had been surprised that so little aid had been given by County Councils to museums. Having sent out a circular to County Council Technical Education Committees, he had found that local museums and free libraries had been assisted in only nine cases. From some counties no information had yet been received, but it would appear from the answers received that there was no insuperable obstacle to the application of money intended for technical education to the development of museums.

In conclusion, Mr. Peek drew attention to the magnificent museum founded at Oxford by General Pitt-Rivers, the arrangement of which was unique.

The Chairman thought they were greatly indebted to Mr. Peek, and invited discussion.

Sir John Evans said that Mr. Peek had left but little for any one to add. He approved of the card catalogue, but thought that the American system of having a perforated card through which a wire passed might perhaps be preferable. He would be glad to know the best way of keeping a cabinet free from dust. He had tried a lining of cotton-wool, but did not think the result perfectly satisfactory. As regards referees for nomenclature and classification, he would suggest the keepers of the various departments of the British Museum, who would always give prompt and valuable assistance.

The Rev. O. P. Cambridge, having a large collection in spirits of wine, had found that the best place for the labels was inside the glass jars, not outside. The writing should be with a pencil.

Sir Rawson Rawson had not always found pencil-marks indelible; and the Rev. O. P. Cambridge added that the pencil should be neither very hard nor very soft.

Dr. Garson could corroborate what had been said as to the advantages of using pencils in spirit preparations. Mr. Gray remarked that variation in the aspect of a museum constituted a most important element of attraction. The circulation of specimens tended, in itself, to make a museum attractive.

Mr. T. W. Shore hoped that Conference might do something towards obtaining aid for museums from County Councils. It was clear that grants could be made by County Councils to defray the expense of lectures and demonstrations in museums.

Mr. Sowerbutts remarked that though County Councils might be subject to the Government auditor, boroughs were not; and Mr. Kenward said that at Birmingham the Corporation had established a museum and art gallery without any help from the County Council.

Mr. T. V. Holmes had in his hands a letter from Mr. W. Cole, secretary to the Essex Field Club, who was most intimately acquainted with technical education as it existed in Essex. Mr. Cole's experience had given him a very low notion